EEGGL Instructions

Igor V. Sokolov[1], Richard E. Mullinix[2], Aleksandre Taktakishvili[2], Anna Chulaki[2], Meng Jin[3], Ward B. Manchester[1], Bart van der Holst[1] and Tamas Gombosi[1]

1. CLaSP, University of Michigan, Ann Arbor MI
2. CCMC, Goddard Space Flight Center, Greenbelt MD
3. Lockheed Martin Solar and Astrophysics Lab, Palo Alto CA

Thanks to Maria M. Kuznetsova and Spiro Antiochos

Introduction

- The new EEGGL tool recently developed at the Goddard Space Flight Center in collaboration with the University of Michigan provides a new capability for both evaluating the magnetic field configuration resulting from the CME and tracing the CME through the solar corona. In this way not only the capability to simulate the magnetic field evolution at 1 AU may be achieved, but the also the more extensive comparison with the CME observations in the solar corona may be achieved.
- Based on the magnetogram and evaluation of the CME initial location and speed, the user may choose the active region from which the CME originates and then the EEGGL tools provides the parameters of the Gibson-Low magnetic configuration to parameterize the CME. The recommended parameters may be used then to drive the CME propagation from the low solar corona to 1 AU using the global code for simulating the solar corona and inner heliosphere. The Community Coordinated Modeling Center (CCMC) provides the capability for CME runs-on-request, to the heliophysics community.

SWMF Run-On-Request with EEGGL

- Simulates Solar Corona (SC) in spherical coordinates (about 3 million cells) and Inner Heliosphere (IH) in Cartesian coordinates, on AMR grid (about 35 million cells) with an improved resolution within the cone in which the CME propagates.
- Superimpose the Gibson-Low configuration with the observationally constrained parameters, to simulate CME
- Steady-state simulation of the state prior to eruption takes approximately 17 hours at 120 CPUs with the CCMC cluster hilo.
- Simulation of 4-10 hours of the CME evolution in the SC and then about 3 days of its evolution in the IH takes approximately 16 hours at 120 CPUs.

Future Work

- We will add a capability to simulate real-time CMEs based on the existing real-time simulations for the ambient.

Demo for CME 2012-07-12

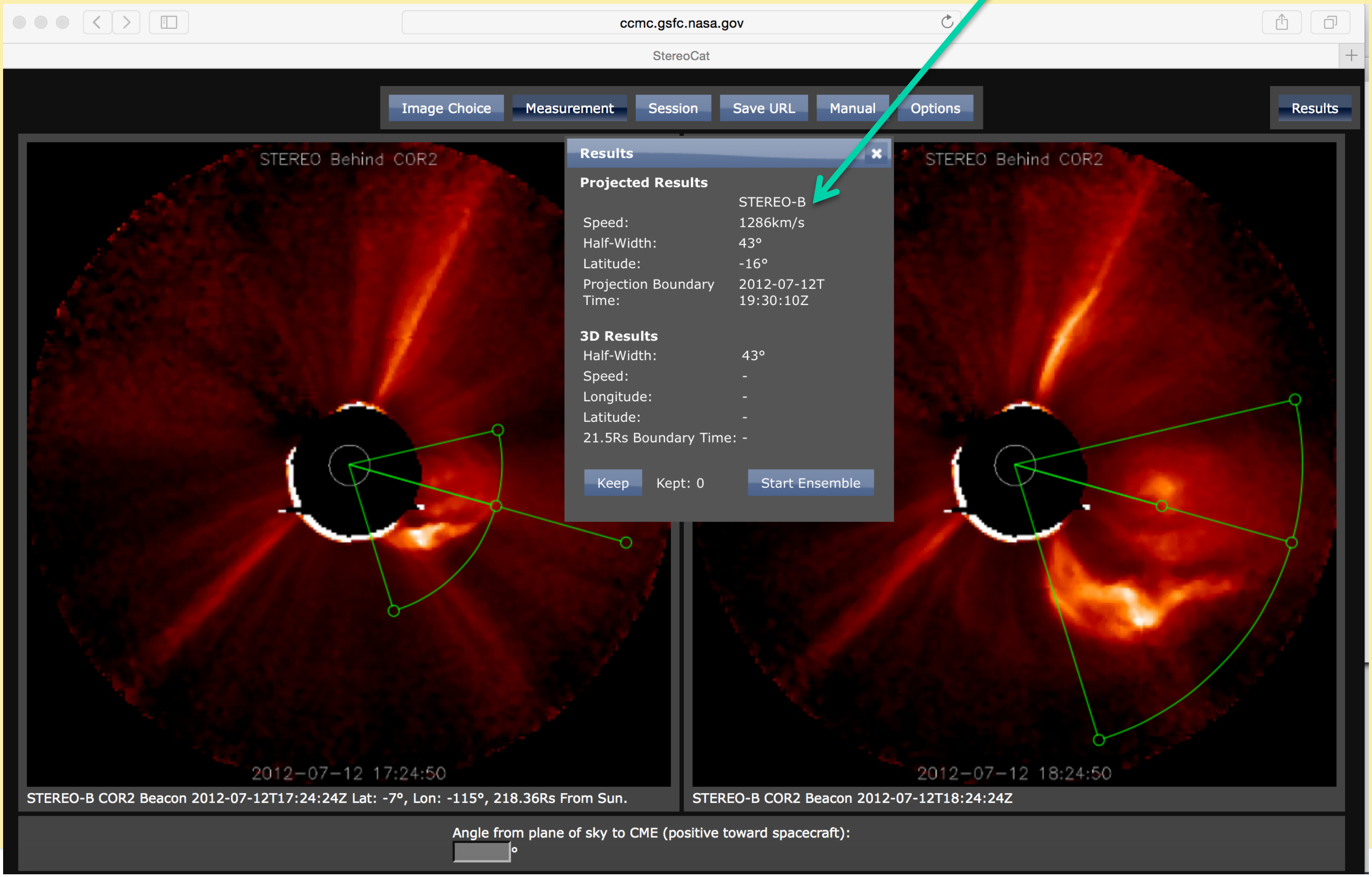
- We demonstrate how the new tools are used to simulate a halo CME 2012-07-12 (https://kauai.ccmc.gsfc.nasa.gov/DONKI/view/CME/14/1)

The List of CME Analysis already entered:

Event Type	Catalog	Data Level	Prime?	Long	Lat	Speed	Type	Half Width	Time 21.5	Note	WSA-ENLIL+Cone Result(s)	Submitted By
CME Analysis	SWRC_CATALOG	0	true	6.0	-13.0	1300.0	O	65.0	2012-07-12T19:29Z	remeasured using the GCS model	Not modeled	Leila Mays on 2015-06-01T19:02Z
CME Analysis	SWRC_CATALOG	0	false	-6.0	-17.0	1400.0	O	70.0	2012-07-12T19:35Z		1: Result 1 (2.0 AU) Earth = 2012-07-14T10:20Z (PE: -7.1 h) Mars = 2012-07-16T00:55Z MESSENGER = 2012-07-13T10:04Z Spitzer = 2012-07-14T13:56Z	Leila Mays on 2013-07-11T21:36Z
CME Analysis	SWRC_CATALOG	0	false	6.0	-9.0	1480.0	O	75.0	2012-07-12T19:31Z		1: Result 1 (2.0 AU) Earth = 2012-07-14T09:17Z (PE: -8.2 h) Mars = 2012-07-16T05:07Z MESSENGER = 2012-07-13T09:59Z Spitzer = 2012-07-14T15:06Z	Anthony Pritchard on 2013-08-08T20:48Z

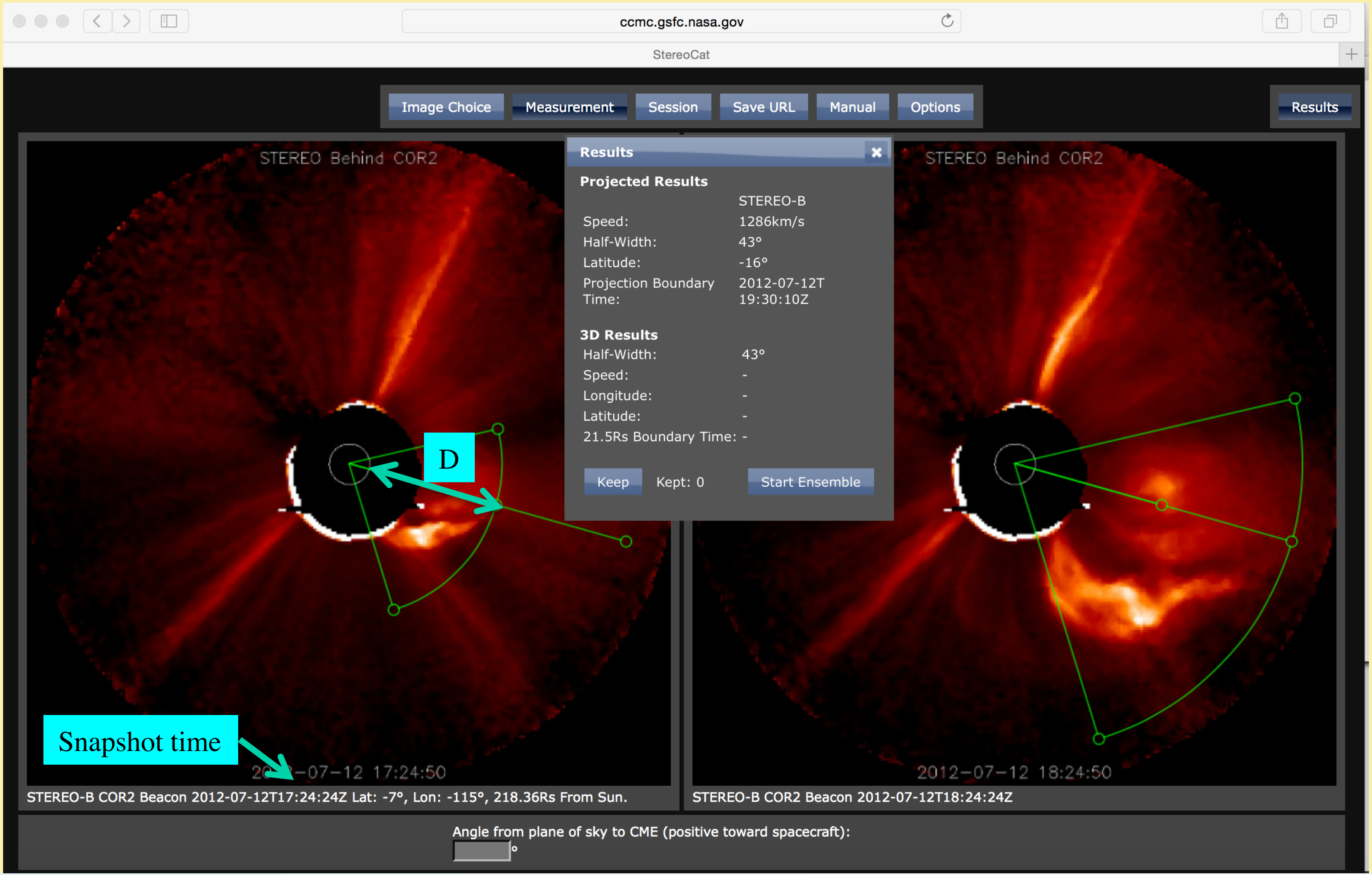
StereoCAT is used to find CME Speed

- StereoCAT (http://ccmc.gsfc.nasa.gov/analysis/stereo/) is developed at the CCMC. By tracing the CME front, we find CME Speed=1300km/s.



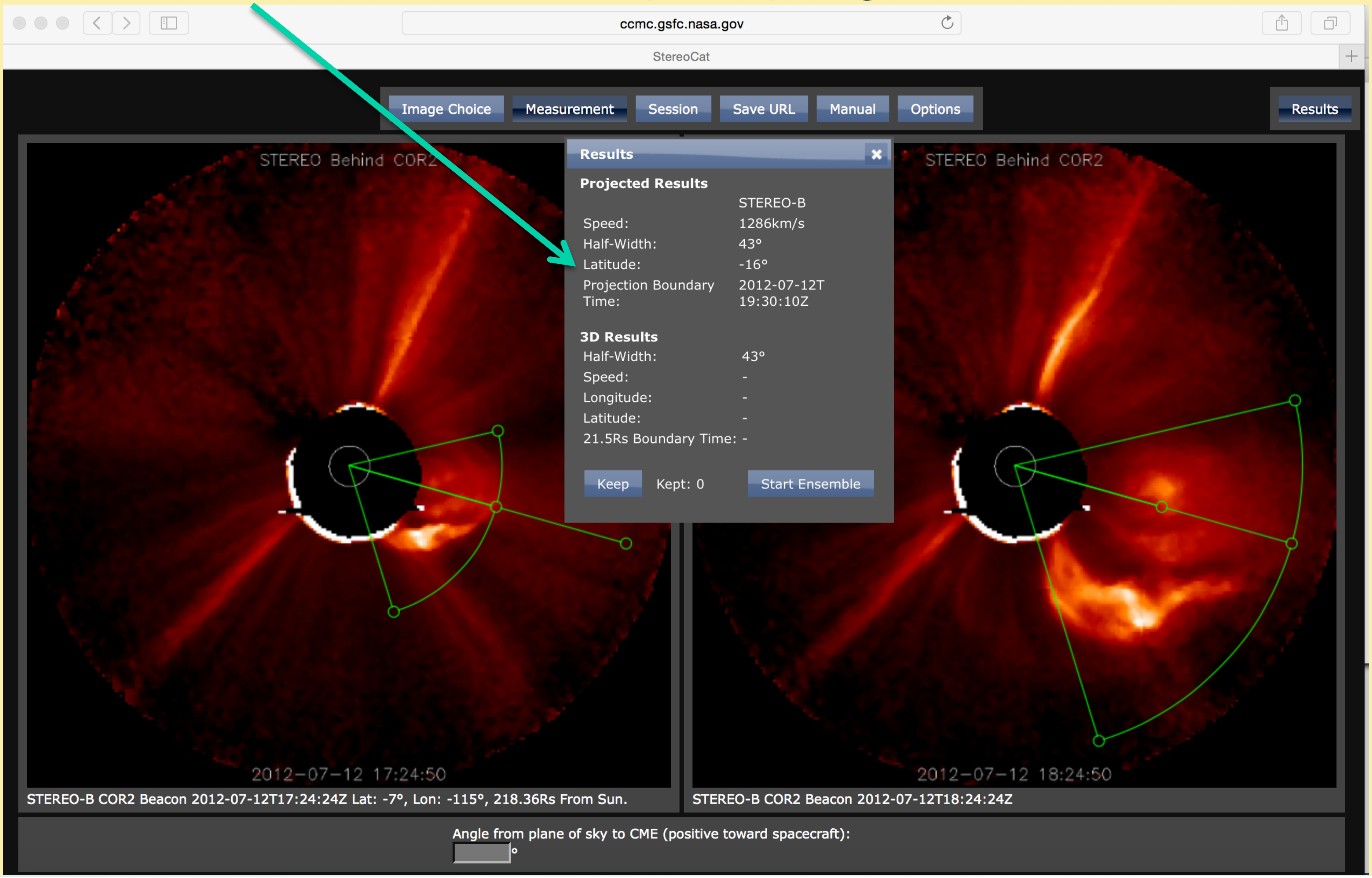
StereoCAT finds CME Start time

- CME start time = Snapshot Time – D/(CME speed) = 13:51



StereoCAT guesses CME place of birth

- Latitude is -20º. Estimates for (HEEQ) longitude are +/- 6º



EEGGL tool

- **EEGGL (Eruptive Event Generator using Gibson-Low configuration – see Splash page http://ccmc.gsfc.nasa.gov/analysis/EEGGLInfo/EEGGL.html**

  and the tool itself: http://ccmc.gsfc.nasa.gov/analysis/EEGGL/) has been recently developed at the CCMC (Goddard Space Flight Center) in collaboration with the University of Michigan.

- **Based on the magnetogram and evaluation of the CME initial location, speed, and start time the user may**
  - choose the active region from which the CME originates;
  - then the EEGGL tools provides the parameters of the Gibson-Low magnetic configuration to parameterize the CME;
  - the recommended parameters may be used then to drive the CME propagation from the low solar corona to 1 AU using the global code for simulating the solar corona and inner heliosphere. To achieve this, the EEGGL has a link to the run submission web page, which helps the user to fill in the request form for a simulation run.

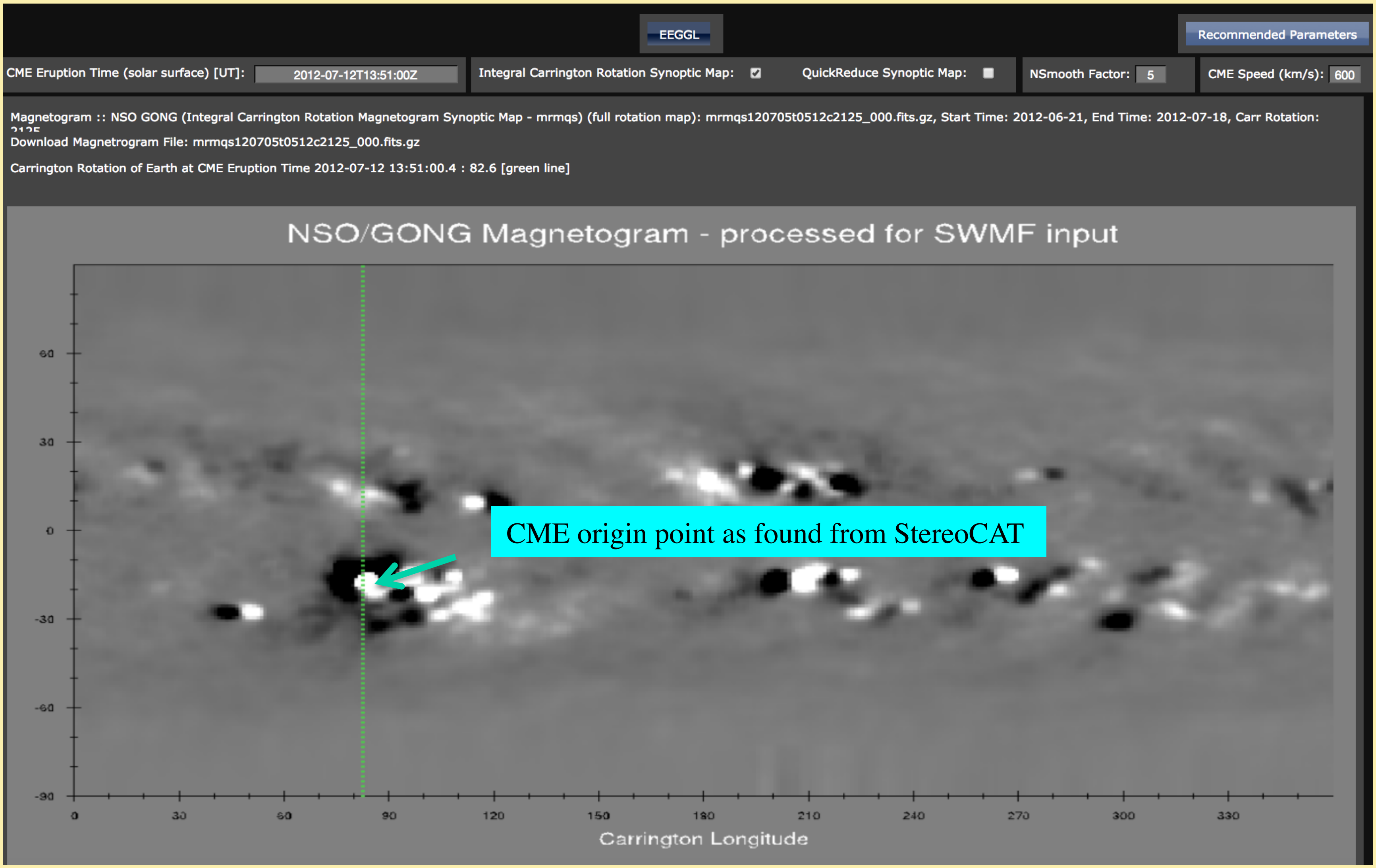
Center for Space Environment Modeling

Space Weather Modeling Framework

Community Coordinated Modeling Center

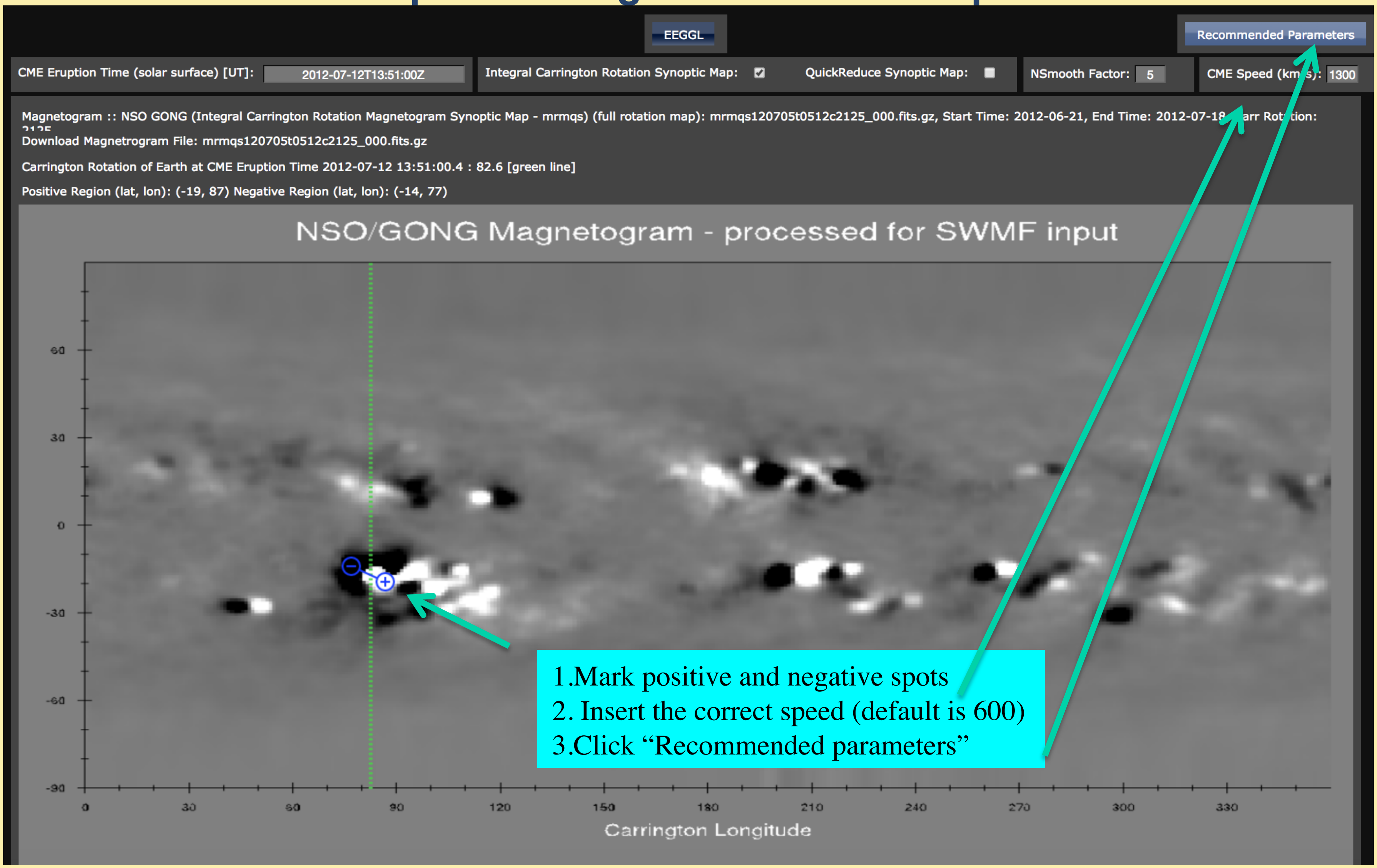
EEGGL tool : chose AR

- For a start time, 2012-07-12.13:51 calculate CR number 2125 and Carrington longitude 83. Find AR in the synoptic magnetic map for



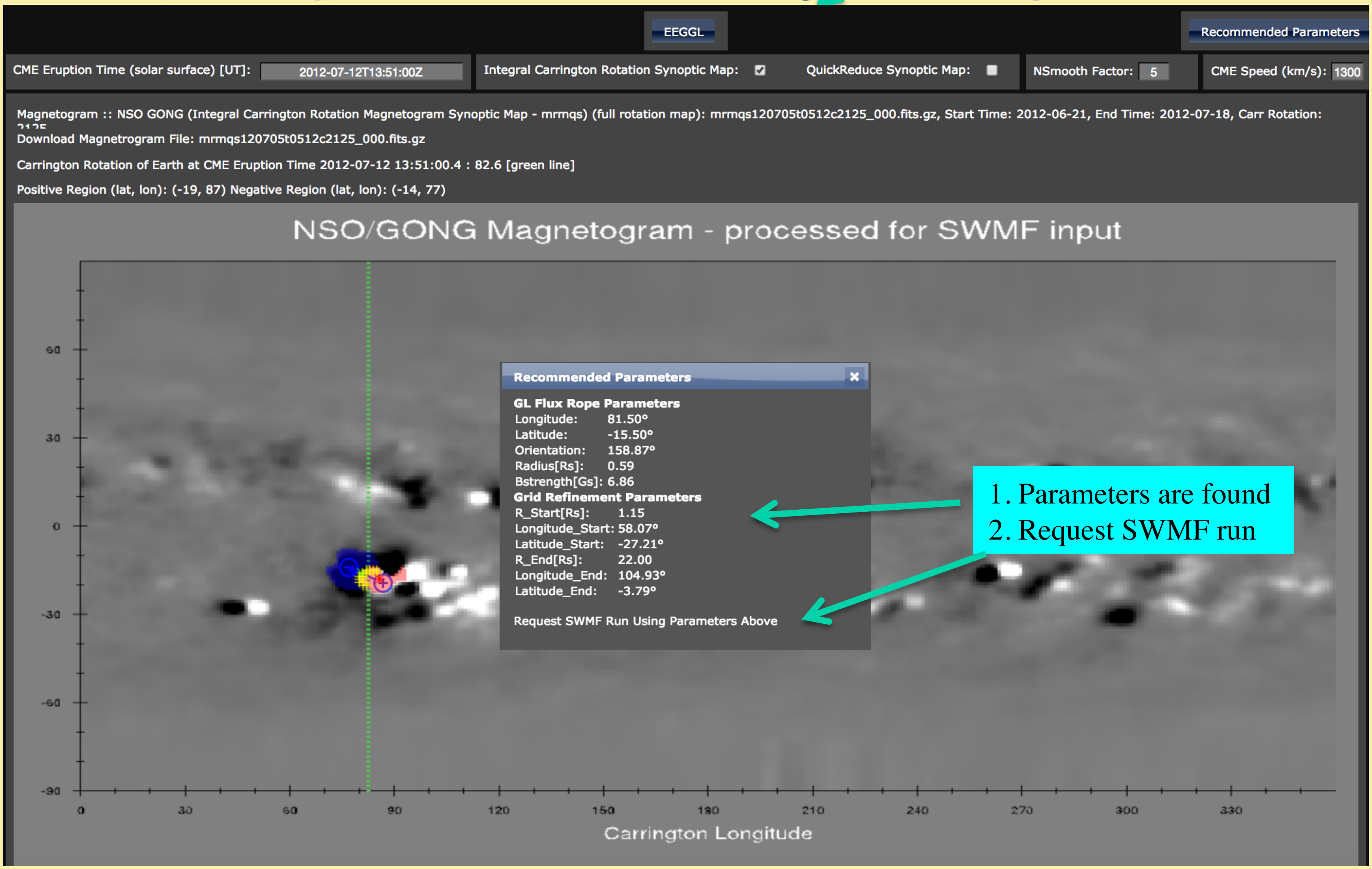
Find Parameters for GL configuration

- Choose and mark bipolar configuration of solar spots in this AR



Parameters are found, request a run

- With the found parameters for GL configuration request a run.



The CCMC Run Submission Interface will appear with your parameters

Related Links | Frequently Asked Questions | Community Feedback | Downloads | Sitemap

About | Models at CCMC | Request A Run | View Results | Instant Run | Metrics and Validation | Education | R2O Support | Mission Support | Community Support | iSWA

EEGGL+Ambient+CME SWMF AWSoM_R Request

CME Eruption Time (at the solar surface)

Run output will be available for 7 days starting with CME Eruption Time selected below.

year	2012
month	July
day	12
hour	13
minute	51

CME DURATION PARAMETERS

CME traveling time in corona* (number of seconds to simulate the CME in the corona), not to exceed 15 hours	16154	seconds
SIMULATION LENGTH* (how many days to follow CME)	5	days

Specify GL FLUX ROPE PARAMETERS

Suggested param. ranges and description. Parameters can be provided by EEGGL.

LONGITUDE* (Carrington) 0 to 360 deg.	82	degrees

Submit Your Run, fill the form and wait

LATITUDE*
(Carrington)
-70 to 70 deg.

-16 degrees

ORIENTATION*
(counter-clockwise with respect to solar equator)
0 to 360 deg.

158.87 degrees

RADIUS*
recommended:
0.3 to 1.5 Rs

0.59 Solar radii

Field Strength*
(the larger the field strength, the faster the CME)
0.5 to 20.0 Gs

6.86 Gs

Specify CONE OPENING ANGLE
Suggested param. ranges and description. Parameters can be provided by EEGGL.

LON OPENING ANGLE*
0 to 40 deg.

23.43 degrees

LAT OPENING ANGLE*
0 to 20 deg.

11.71 degrees

SETTING PARAMETERS of AWSoM_R MODEL

POYNTING FLUX RATIO*
Ratio of Poynting flux to magnetic field strength at the photosphere level, assumed to be a constant parameter in AWSoM_R model
0.3 to 1.2

1.0 $\times 10^6$ $J/(m^2 s T)$

CORONAL HEATING*
Perpendicular correlation length times the square root of local magnetic field intensity, assumed to be a constant parameter in AWSoM_R model
0.7 to 3.0

1.5 $\times 10^5$ $m T^{1/2}$

SUBMIT RESET